B6
INHERITANCE & VARIATION
TEST 1
Mark schemes

(a) Nucleus

(b) Type of cell | Number of chromosomes
---|---
Sperm cell | 23
Embryo cell | 52

extra lines from left cancel the mark

(c)

<table>
<thead>
<tr>
<th>X</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>XX</td>
</tr>
<tr>
<td>Y</td>
<td>XY</td>
</tr>
</tbody>
</table>

all three correct for 2 marks
one or two correct for 1 mark
allow XY or YX in correct places
(d) Either circled

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>XX</td>
<td>XX</td>
</tr>
<tr>
<td>Y</td>
<td>XY</td>
<td>XY</td>
</tr>
</tbody>
</table>

(e) 1 in 2

(a) | Characteristic | Environmental | Genetic | Both |
<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye colour</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A scar</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td></td>
<td>✔️</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(b) **Key term**

- **Genotype**
  - The set of alleles for a characteristic
- **Phenotype**
  - The physical characteristics of an organism
  - The mutation of genes
  - The inheritance of chromosomes
  - The genus of an organism

*extra lines from the left negate the mark*
<table>
<thead>
<tr>
<th>Stage in selective breeding</th>
<th>Order of stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows are bred over many generations</td>
<td>4</td>
</tr>
<tr>
<td>Parents are bred together</td>
<td>2</td>
</tr>
<tr>
<td>Cows with the desired characteristics are chosen</td>
<td>1</td>
</tr>
<tr>
<td>Calves with the most desired characteristics are bred together</td>
<td>3</td>
</tr>
</tbody>
</table>

all 3 correct for 2 marks
1 or 2 correct for 1 mark

max. 2

(d) beef / meat

*allow hardiness, disease resistance*

milk yield

(e) higher veterinary costs

less income from sale of (milk and meat) products

(a) When the dominant allele is not present.

(b) (i) Bb
3 correct = 2 marks
2 correct = 1 mark
1 or 0 correct = 0 marks
allow bB for Bb

(iii) 1 in 2
allow ecf from part ii

(a) same name to everyone

(genus) part gives information on ancestry

(b) any one from:

- DNA / RNA analysis
- improvements to (electron) microscopes
- improved understanding of biochemical processes
- evidence of internal structures being more developed

(c) primitive bacteria / prokaryotes

(often) from extreme environments / extremophiles
(a) organisms that reproduce together to form fertile offspring

(b) (i) fossils of P and Q in same stratum / layer / level / height

(ii) earlier – fossil in deeper layer / further down

(iii) the fossils of animals S and T have many features in common, but T is more complex than S

the fossil of animal S was found in a deeper layer of rock than the fossil of animal T

(c) (i) X has white tail / shorter tail

\[\text{allow other points eg } X \text{ has furrier tail / smaller feet / is furrier}\]
\[\text{or}\]
\[W \text{ has sharper claws / } W \text{ has larger claws}\]

(ii) two (ancestral) populations separated / isolated (by geographical barrier / by canyon / river)

 genetic variation (in each population) / different alleles / different genotypes / (different) mutation(s)

 different environmental conditions / example described

\[\text{allow abiotic or biotic example}\]

 the better adapted survive / natural selection occurs

\[\text{allow survival of the fittest}\]
\[\text{ignore they adapt to the environment}\]

 so (different / favourable) alleles / genes passed on (in each population)

 eventually two types cannot interbreed successfully

\[\text{allow to produce fertile offspring}\]
(iii) any two from:
- environments similar / described
  allow example, e.g. similar predator(s) / food / climate
- therefore similar adaptations / features / phenotypes suit
  accept suitable named feature
- original ancestor already well adapted
  ignore reference to not enough time for evolution.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell membrane</td>
<td>Controls the movement of substances into and out of the cell</td>
</tr>
<tr>
<td></td>
<td>Carries genetic information</td>
</tr>
<tr>
<td>Plasmid DNA</td>
<td>Provides support and protection</td>
</tr>
<tr>
<td></td>
<td>The site of protein synthesis</td>
</tr>
</tbody>
</table>

extra lines from the left negate the mark

(b) Contaminated food

(c) any two from:
- cook food (thoroughly)
- pasteurise food
- wash hands properly
- disinfect work surfaces
- keep raw and cooked foods separate
- only drink clean water

(d) It will not cause sickness and diarrhoea side effects

(e) E

B

D

(a) cross / breed / mate different breeds of horse

if the offspring are fertile then the two breeds are of the same species
(b) select the fastest male and female to cross / mate  
   *allow any relevant characteristic, eg stamina*
   
   select the fastest offspring and breed them
   
   repeat over several generations to produce faster horses

(c) gene for the Bt poison is cut from the bacterial DNA / plasmid / chromosome  
   *ignore characteristic*
   *accept Bacillus thuringiensis*
   
   using enzymes(s)
   
   and transferred to cotton plant cells / DNA / chromosome  
   *do not allow to cotton plant plasmid*

(d) any **four** from:
   
   *must have both advantages and disadvantages for full marks*

   **advantages**
   
   • increased yield as less eaten by insects
   • fewer pesticides need to be used
   • (so) producer can make more money

   *this point may only be gained if linked to one of the points above*

   **Disadvantages:**
   
   • gene (for poison) could be passed on to wild plants
   • may kill useful insects

   *allow named insect eg bees*

   • ecosystem / food chain could be affected
   • gene pool of cotton plants could be reduced

   *allow less variation in cotton plant population*
(a) testis / testes

allow testicle(s)

1

(b) (i) \( B = 13.2 \)
\( C = 6.6 \)
\( E = 3.3 \)

all 3 correct = 2 marks
2 or 1 correct = 1 mark

If no marks awarded allow ecf for \( C \) and \( E \) based on answer to \( B \)
ie \( C = \frac{1}{2} \) \( B \) and \( E = \frac{1}{2} \) \( C \) for one mark

2

(ii) 6.6

allow twice answer for cell \( E \) in part bi

1

(iii) mitosis

correct spelling only

1

(c) (i) any two from:

- cells that are able to divide
- undifferentiated cells / not specialised
- can become other types of cells / tissues or become specialised /differentiated

allow pluripotent

2

(ii) 4-day embryo is a (potential) human life

or

destroying/damaging (potential) human life

allow cord would have been discarded anyway
ignore reference to miscarriage
allow cannot give consent

1

(iii) perfect tissue match or hard to find suitable donors

allow same/matching antigens
allow no danger of rejection
allow no need to take immunosuppressant drugs (for life)
ignore genetically identical or same DNA

1

(iv) stem cells have same faulty gene / allele / DNA / chromosomes

allow genetically identical
ignore cells have the same genetic disorder

1
(a) any two from:
• larger / longer / thicker
  allow examples eg fewer toes or bones fused
• fewer (bones in total)
  allow smaller surface area touching the ground
• fewer bones touching the ground

(b) (i) large(r) surface / area in contact with the ground

or

low / less pressure on ground

(so) less likely to sink into mud / ground

or

(so) could run fast(er)
  allow easy / easier to escape predators

(ii) variation (in size / number / arrangement of bones)
  allow mutation(s) (in size / number / arrangement of bones)

(and) those with large(r) / few(er) bones more suited to running or run faster (on harder / drier ground)

these survive and breed
  allow ref to offspring for breed

(so) genes / DNA (for larger / fewer bones) passed on
  allow alleles passed on

(a) Man's genotype Hh
  both needed for the mark

Woman's genotype hh

(b) gametes correctly derived from parents genotypes in 05.1

offspring genotypes correctly derived from gametes
all Hh circled

<table>
<thead>
<tr>
<th>Man’s gametes</th>
<th>Woman’s gametes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>h</td>
</tr>
<tr>
<td>H</td>
<td>Hh</td>
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<tr>
<td>h</td>
<td>hh</td>
</tr>
</tbody>
</table>

(Probability =) any one from:

- 50%
- ½
- 2 / 4
- 0.5
- 1 in 2
- 2 in 4
- 1:1
- 2:2

(c) Level 3 (5–6 marks):
A detailed and coherent evaluation is provided which considers a range of relevant points and comes to a conclusion consistent with the reasoning.

Level 2 (3–4 marks):
An attempt is made to relate relevant points and come to a conclusion. The logic may be inconsistent at times but builds towards a coherent argument.

Level 1 (1–2 marks):
Discrete relevant points made. The logic may be unclear and the conclusion, if present, may not be consistent with the reasoning.

0 marks:
No relevant content

Indicative content
- adoption / gamete donation unsuitable as offspring not biologically theirs
- natural conception too risky / only 50% chance of healthy offspring
- natural conception would cause worry whether baby would be healthy or not
- (therefore) choice is between PGD and PND
pros of PGD
• baby would be theirs
• results obtained at an early stage
• high chance baby produced would be healthy
• parents would have confidence of having a healthy baby from start of pregnancy
• lower risk of miscarriage compared to PND
• frozen embryos can be used to have another healthy child
• PGD occurs before pregnancy / implantation
• PGD does not involve abortion so less trauma / less pain / ethical comparison
• spare healthy embryos may be used for research / medical treatment

cons of PGD
• slight / 0.2% chance of misdiagnosed embryo
• expensive procedure
• cost to NHS of non-essential procedure
• (unhealthy) embryos might be destroyed
• large number of embryos produced so healthy embryos may be destroyed
• ethical issues of using embryos for research
• some people are opposed to IVF due to their religious beliefs

pros of PND
• natural conception less invasive for mother
• psychological benefit of producing child naturally
• 99% / high chance that result of test will be conclusive

cons of PND
• sampling technique invasive to mother
• risk of miscarriage
• risk of infection
• long wait before test can be carried out
• 50% chance baby will have allele for Huntington’s disease
• parents will have a difficult decision to make if baby is unhealthy
• baby may be aborted
• ethical / religious issues of abortion
• a justified conclusion